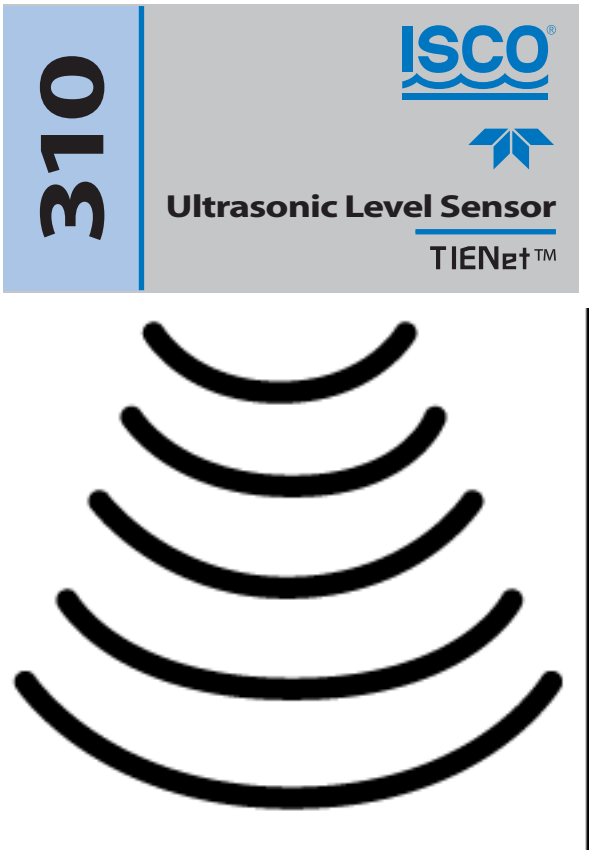
TIENet® 310 Ultrasonic Level Sensor

Installation and Operation Guide



TELEDYNE ISCO
Everywhereyoulook™

Manual Body #69-4313-010
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Revision C, May 2015

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne Isco technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the **Return Merchandise Authorization (RMA)** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Fax:	(402) 465-3022	
Email:	IscoCSR@teledyne.com	

Technical Support

Phone:	Toll Free (866) 298-6174	(Samplers, Flow Meters and Multi-parameter Probes)
	Toll Free (800) 775-2965	(Syringe Pumps and Liquid Chromatography)
Email:	IscoService@teledyne.com	
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398	

Other Correspondence

Mail to:	P.O. Box 82531, Lincoln, NE 68501-2531
Email:	IscoInfo@teledyne.com

Revised April 2014

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:

⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

TIENet™ Model 310 Ultrasonic Level Sensor

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TIENet® Model 310 Ultrasonic Level Sensor

Section 1 Introduction

The Signature® Flow Meter uses the TIENet 310 Device to provide non-contact liquid level measurement. The flow meter has built-in level-to-flow conversions that cover the majority of open channel flow measurement situations.

1.1 Description

The ultrasonic sensor is mounted over the flow stream. The flow meter measures the time interval between transmission of a sound pulse from the sensor, and receiving its echo off the surface of the liquid, to determine the level of the stream.

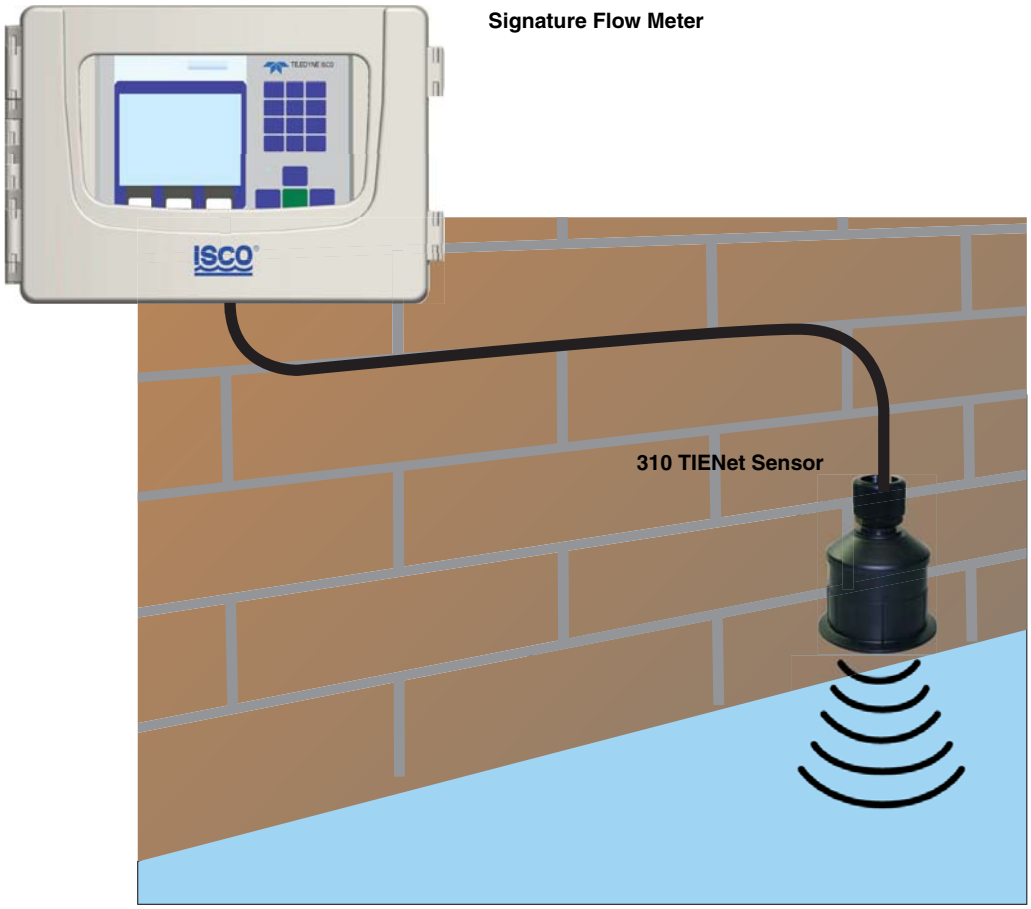


Figure 1-1 Basic Signature monitoring system with 310 (mounting hardware not shown)

This non-contact measurement method reduces the frequency of maintenance, and is ideal for applications where the flow may contain chemicals, grease, silt, or suspended solids.

1.2 310 Sensor Design

The ultrasonic level sensor consists of a housing with a single transducer that is both pulse transmitter and echo receiver. A temperature sensor within the housing measures the ambient temperature, and a microprocessor automatically compensates for speed-of-sound changes due to any changes in air temperature.

The 310 is available with a 10m, 23m, and special order to 150m or less cable lengths with or without connectors. For greater distances, external connection via conduit, and connection of additional TIENet devices, the TIENet Expansion Box is available. Bulk TIENet cable may also be used for greater distances.

Figure 1-2 310 Ultrasonic TIENet Sensor with unterminated leads (l) or TIENet plug (r)

1.3 Operation

The sensor emits multiple ultrasonic pulses per second. Between pulses, the transducer switches from transmitter to receiver. When the transducer receives the echo from the water's surface, the sound energy is converted into an electrical signal. The signal is then amplified and processed by the Signature flow meter into an "echo-received" signal. The time between the transmitted pulse and the echo-received signal is proportional to the distance between the transducer and the liquid surface. This distance in turn determines the liquid level used to calculate flow.

1.4 Technical Specifications

Table 1-1 310 TIENet Device Specifications[a]

Sensor Dimensions	3.63" ∅ x 4" tall	(9.1cm ∅ x 10.2cm tall)
Cable Length	10 or 23 meters standard	(32.8 or 75.5ft) standard
Mounting Attachment	3/4" NPT Pipe thread nipple w/ Conduit lock nut	
Weight	4 lbs	(1.8 kg)
Body Material	PVDF	
Enclosure	IP68 when connected and properly sealed with cord-grip fitting.	
Temperature Range Operating (compensated) Storage Hazardous Locations	 -22 to 140°F -40 to 158°F -40 to 140°F	 (-30 to 60°C) (-40 to 70°C) (-40 to 60°C)
Measurement Range	Minimum: 1 ft (0.3m) from sensor to liquid surface Maximum: 11 ft (3.3m) from sensor to liquid at minimum level	
Measurement Accuracy at 72 °F (22 °C)	±0.02ft (0.006m) at 1ft level change or less; ±0.03ft (0.009m) at greater than 1ft level change	
Temperature Coefficient within compensated range	± 0.0002 x D (m) per degree C ± 0.00011 x D (ft) per degree F (Where D is the distance from the transducer to the liquid surface)	
Beam Angle	10°	5° From center line
Ultrasonic Signal	50KHz	
Certifications	Group II, Category 1G (zone 0), T4 Class I, Division 1 (and Zone 0), T4	

a. All specifications are subject to change without notice.

1.5 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

> **☑ Note**
>
> Only the Wall Mount Bracket is approved for use in classified hazardous locations. Other accessories must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

Spreader Bar – The Spreader Bar is an expandable pipe for suspending equipment inside a manhole. Outward spring pressure secures it against the manhole walls, like a shower curtain rod. Depending on your application, you can then suspend the 310 TIENet Device, or the Signature Flow Meter itself, from the bar.

Cable Straightener – The cable straightener is designed for use in installations where the transducer is suspended by its cable only, such as from the Spreader Bar. The straightener helps hold the transducer vertically plumb, thereby stabilizing alignment.

Cable Clamp – The cable clamp is used with the Spreader Bar to secure the mounting of the sensor.

Wall Mount Bracket – This device lets you install the ultrasonic level sensor on a convenient nearby wall over a flow stream, such as the side of a bridge, or other structure.

Floor Mount – The Ultrasonic Floor Mount is a collapsible metal stand attached to the floor, for extending the sensor out over a flow stream.

Ultrasonic Calibration Target – This option is designed to make calibration of the level sensor more accurate during the installation process by letting you calibrate the level sensor from outside the manhole.

Sunshade – The ultrasonic sunshade is a white plastic cap that fits over the top of the ultrasonic transducer. Its purpose is to keep sunlight from heating the body of the level transducer and introducing temperature errors to the internal temperature compensation.

1.5.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA
Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022
E-mail: IscoInfo@teledyne.com

1.5.2 TIENet 310 Ultrasonic Level Sensor

310 Ultrasonic Level Sensor with Signature connection ending in unterminated leads. For use with Signature 6 position plug-in (green) terminal strip.

Includes cord grip and sensor with cable. (See cable lengths below).

310 Ultrasonic sensor w/ 10m cable 60-4314-005
310 Ultrasonic sensor w/ 23m cable 60-4314-006
310 Ultrasonic sensor Cut-to-length 60-4314-014
Cut to length cable up to 999 ft* 60-4304-050
*Cable lengths can go up to 150 m with an expansion box.

310 Ultrasonic Level Sensor with Signature connection ending in TIENet plug. For use with portable Signature TIENet receptacle.

Includes cord grip and sensor with cable. (See cable lengths below).

310 Ultrasonic sensor w/ connector and 10m cable 60-4314-009
310 Ultrasonic sensor w/ connector and 23m cable 60-4314-011
310 Ultrasonic sensor w/ connector Cut-to-length* 60-4314-013
Cable Assembly with TIENet Y w/ connector 60-4304-066
*Cable lengths can go up to 150 m with an expansion box.
Sunshade for ultrasonic sensor 60-3004-142
Spreader bar for suspension of sensor or flow meter in manhole shaft 60-3004-110
Cable clamp 60-3004-129
Sensor Mounting Bracket U/S 60-2003-615
Floor mount for horizontal surfaces 60-2004-611
Cable straightener for suspension over stream 60-4313-009
Ultrasonic calibration target 60-3004-143
TIENet Expansion Box 60-4307-023

Kit includes 10ft TIENet cable

Cord grip fitting, 3/4" NPT, for TIENet cable 209-0073-12
Barrier for Signature (SPA 2060) 60-5324-060

> **☑ Note**
>
> Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

TIENet® Model 310 Ultrasonic Level Sensor

Section 2 Installation and Setup for Signature

The Signature Flow Meter does not have to be mounted near the flow stream. You can install the flow meter itself at a convenient, protected location and route the sensor cable to the measurement point. Proper installation of the 310 sensor is critical for accurate measurement.

2.1 Sensor Installation Considerations

Measurement accuracy can be affected by a number of site factors that should be taken into consideration when selecting the location for the sensor. If the sensor cannot obtain a valid reading, an asterisk (*) will appear next to the displayed level, indicating there is an error.

2.1.1 Beam Angle

The 310 sensor has a 10° beam angle, forming a cone whose apex is the ultrasonic transducer. The sensor can only detect surfaces within this cone. Narrow channels can result in false echoes and incorrect level readings off the walls and sides of the channel. For preventive measures, see Section 2.5.2 *Measurement Setup*, and the programming steps in Figure 2-14.

The beam becomes narrower at shorter distances, which can increase difficulty in detecting the return echo. If the beam is too wide, the sensor may pick up signals from unwanted surfaces, such as the walls of the channel.

Sensor elevation is highly specific to the particular site.

2.1.2 Humidity

Conditions of extremely high or low humidity can cause detection to occur either earlier or later than under normal conditions. A drop in water level, normally compensated for by the sensor's interval-based amplifier, may produce errors in echo detection.

Additionally, water droplet condensation on the bottom surface of the sensor can cause measurement errors.

2.1.3 Surface

Solids, foam, oil, and turbulence can all absorb or weaken the ultrasonic pulses, causing errors in detection. Foam or oil on the surface of the stream can produce false level readings.

2.1.4 Temperature

Changes in ambient temperature significantly affect the velocity of sound. If ambient temperature changes rapidly, there may be a delay before the 310's temperature sensor can activate temperature compensation.

If the sensor will be installed outdoors in direct sunlight, use a sunshade to prevent heating of the sensor housing.

2.1.5 Waves

Waves on the surface of the flow stream can deflect the ultrasonic signal, causing erroneous readings or total loss of signal. The Signature Flow Meter software is able to reject occasional readings that deviate substantially from normal.

2.1.6 Wind

Strong winds can significantly reduce the strength of the return echo. Narrow beams can result in the sound being blown away; likewise, greater distances to the flow stream surface are more subject to distortion in strong winds.

2.1.7 Hazardous Locations

Installation in classified hazardous locations must meet specific conditions in order to fulfill safety requirements. Installation must be performed only by trained, qualified personnel. Refer to Section 2.4 *Installation in Hazardous Locations* for complete information.

2.2 Connecting the Cable

External TIENet devices such as the 310 are all connected to the Signature flow meter in the same manner. These connections usually use conduit or cord-grip cable fittings for permanent mounted meter or with TIENet receptacle for portable meters. Multiple external TIENet devices can be connected simultaneously.

Refer to your Signature flow meter manual for instructions on accessing the instrument's interior components.

> ☑ ***Note***
>
> The steps that follow include instructions for installing cord-grip fittings. Some applications will require cables to be routed through user-supplied conduit. Conduit with a minimum $^{3}/_{4}$" ID is suggested for unterminated sensor cables and conduit with minimum $1\text{-}^{1}/_{2}$" ID is suggested for straight runs for sensor cables with connectors.

2.2.1 Permanent Meters

> ☑ ***Note***
>
> Before proceeding, ensure that the flow meter has been disconnected from mains power.

1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

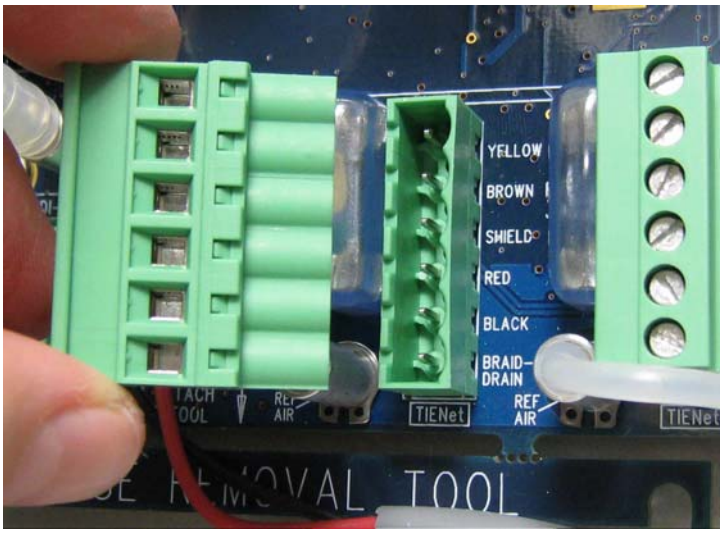


Figure 2-1 TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).
3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

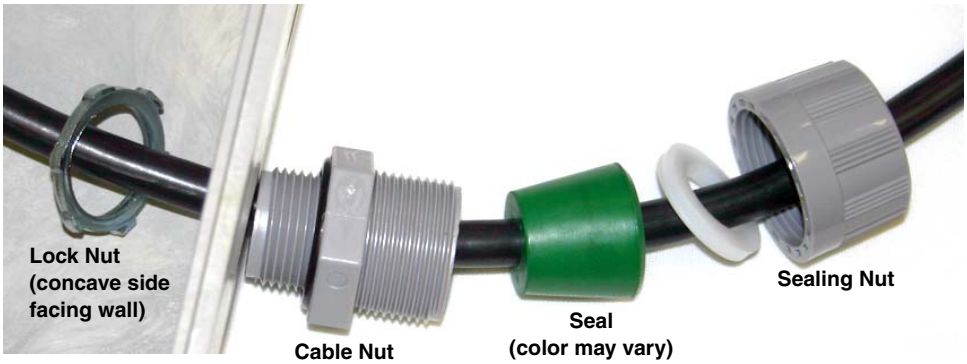


Figure 2-2 Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-3, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-4, taking care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

Note

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.The drain wires need to be kept very short.

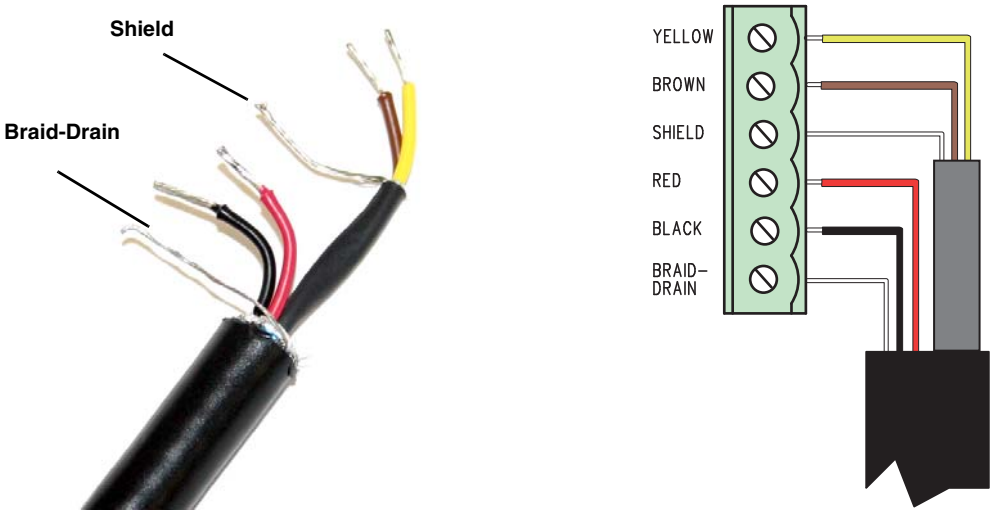


Figure 2-3 TIENet Device terminal connections

5. Press the terminal strip back down into its socket on the case board, as shown in Figure 2-5, taking care not to strain any wire connections. The 310 sensor cable does not include a reference air connection (Figure 2-4).

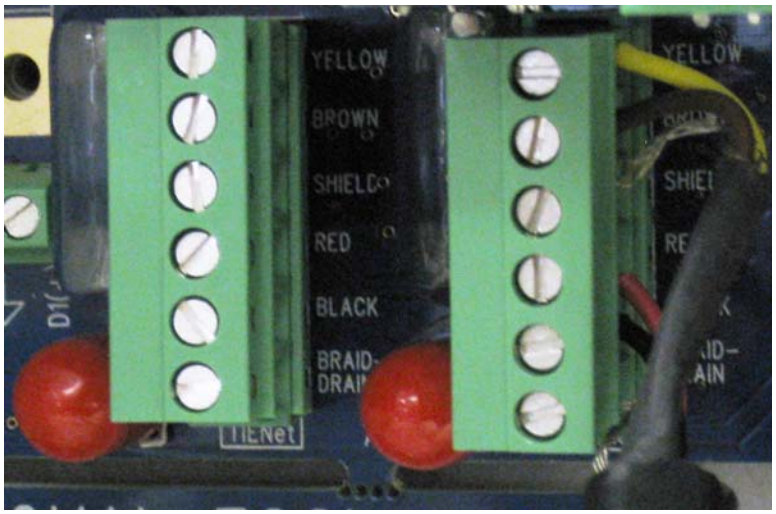


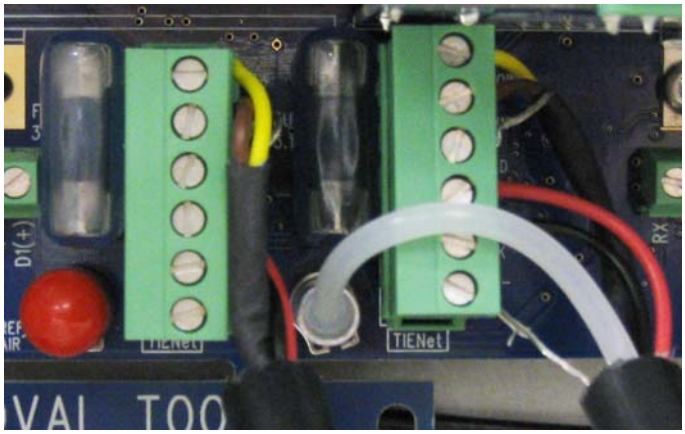
Figure 2-4 Attach wired terminal strip to case board socket

6. Gently tug the cable downward, to remove any slack within the enclosure, taking care not to put any stress on the connection.
7. Tighten the cord grip sealing nut.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

8. Close the front panel and fasten it shut with the two Phillips screws.



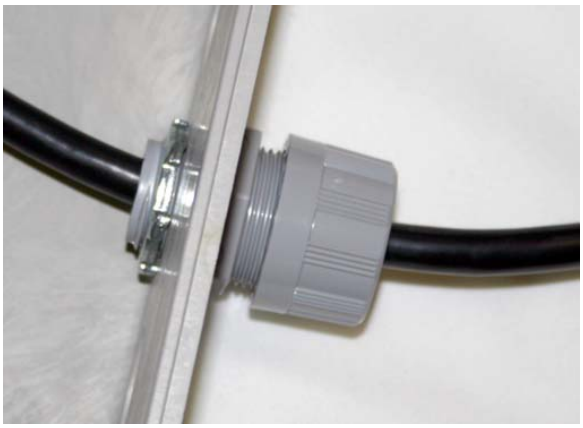


Figure 2-5 Position and secure the cable

2.2.2 Connecting to Signature Portable via a TIENet Receptacle

The optional external TIENet devices compatible with the Signature Portable (and Signature) all scan into the hardware in the same manner. A scan is required anytime a new TIENet device is added.

Multiple TIENet devices can be connected simultaneously to the same Signature Portable Flow Meter. The following TIENet devices will attach to the TIENet receptacle:

- Ultrasonic Level Sensor

- Area Velocity Sensor
- 301 pH Interface
- LaserFlow
- 306 Sampler Interface

Connecting a TIENet plug to the Signature Portable

To connect the TIENet plug from the sensor to the TIENet Receptacle:

1. Align the connectors and push together (Figure 2-6).
2. After the physical connection is made, a scan must be performed for the device to be recognized.

For additional TIENet connections, use the TIENet Y-cable or alternately an Expansion Box.

O-Ring and Lubrication for the TIENet receptacle

1. Coat the O-ring's sealing surface with a silicone lubricant.

⚠ CAUTION

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum-based propellents. If you are using an aerosol spray, allow a few minutes for the propellent to evaporate before proceeding.

2. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.
3. Connect the two caps together.

Figure 2-6 How to connect a TIENet plug to the Signature Portable

2.3 Sensor Installation

The mounting location of the ultrasonic level sensor depends on the type of primary measuring device (such as a weir or flume), and on the method of level-to-flow conversion used. Refer to the *Isco Open Channel Flow Measurement Handbook* included with your Signature flow meter, or to instructions provided by the manufacturer of the primary device, for detailed information about locating the measuring point.

If you intend to measure flow by some other means, such as a gravity flow equation (Manning) or by calibrating a section of the flow channel, you must locate the measuring point based on the hydraulic characteristics of the channel, as well as the level-to-flow conversion method.

In most open channel installations where the level may exceed one-half of full pipe, mount the sensor as near as possible to the midpoint between the entrance and exit to measure over the least turbulent flow.

2.3.1 Dead Band

Mount the sensor as close as possible to **one foot** (0.3 m) above maximum expected level. The sensor cannot measure within the foot of space directly below it, called the *dead band*.

2.3.2 Submersion and Fouling

Fouling by grease or solids can cause the sensor to malfunction. The sensor is sealed, so unless it was exposed to corrosive substances, temporary accidental submersion should not harm it. Upon retrieval, ensure that the sensor's surface is clean. Clean the bottom surface very gently with running water and a soft cloth.

2.3.3 Mounting Options

The 310 sensor can be mounted over the flow stream in various ways, depending on which method best fits the application.

Optional equipment is available from Teledyne Isco for wall, floor, suspension, and horizontal mounting (see Section 1.5 *Accessories*). The sensor has a $^{3}/_{4}$" NPT male pipe thread with a conduit lock nut to connect it to a mounting bracket or cable stiffener. The sensor cable can be routed through user-provided conduit back to the Signature Flow Meter.

Regardless of the mounting method you select, always place the sensor over the center of the stream, and always use a circular bubble level for vertical alignment.

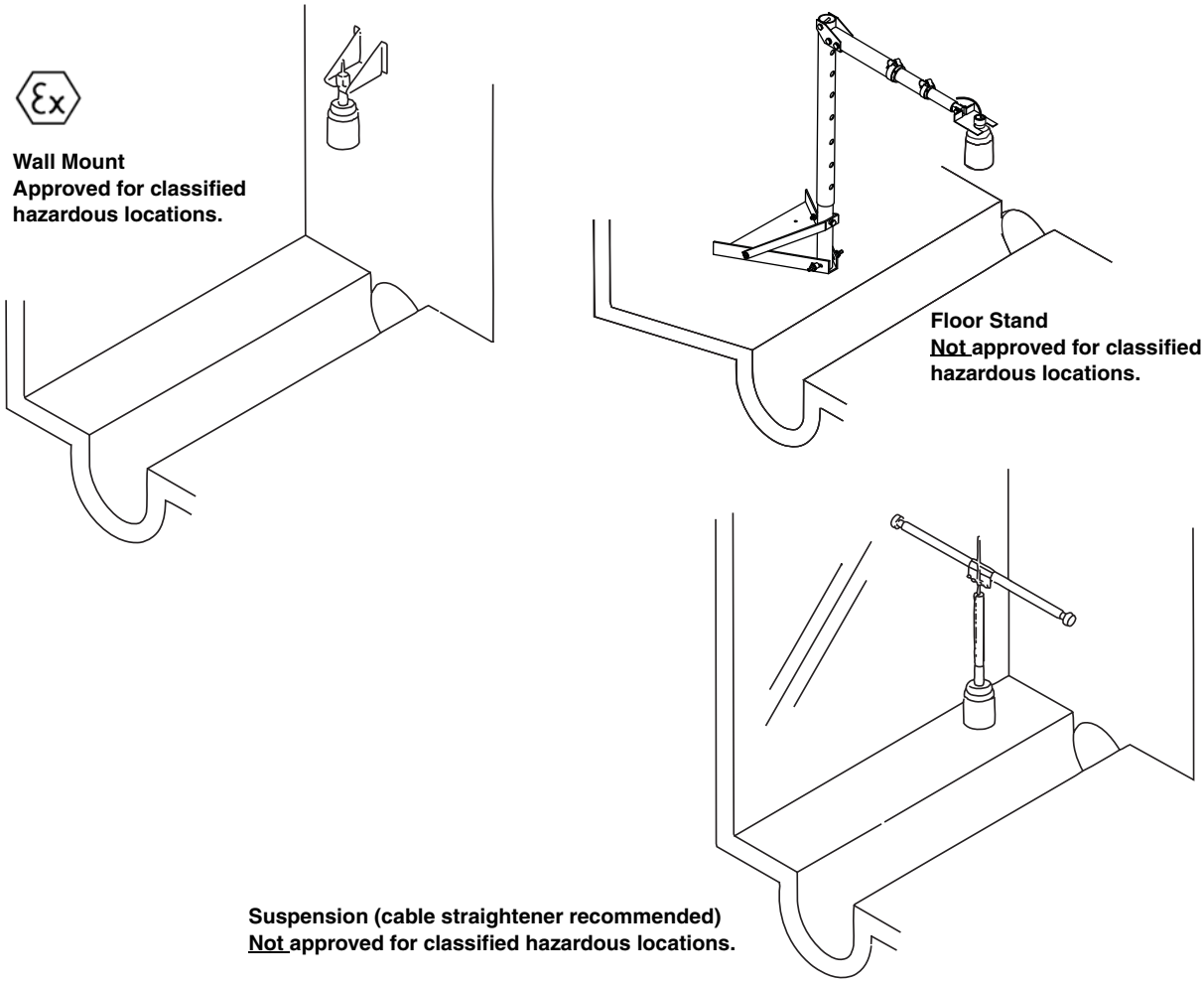

Wall Mount
Approved for classified hazardous locations.
Floor Stand
Not approved for classified hazardous locations.
Suspension (cable straightener recommended)
Not approved for classified hazardous locations.

Figure 2-7 Sensor mounting options

2.4 Installation in Hazardous Locations

Read all labels carefully before installing the equipment!

The TIENet Model 310 device is ATEX-approved for use in potentially explosive atmospheres when specific conditions are met, as described in this section in reference to "X" Marking.

The 310 is Group II, Category 1G equipment for use in gas hazard zones 0, 1, and 2 (European standards), or Class I Division 1 (North American standards).

The braid-drain lead depicted in Figure 2-8 *Sensor labeling regarding hazloc installations* is normally bonded to earth through the Signature connector case terminals or conduit; it is also electrically connected to the anti-static conductive housing of the 310 sensor.

Installation must be performed only by trained, qualified personnel.

Barriers or isolators required for certifiable safe installation are the responsibility of the user. Refer to the control drawings provided in Figures 2-9 and 2-10.

☑ Note

There is TIENet barrier (a weatherproof box with terminals and power supply) available for hazardous locations (PN# 60-5324-060). Contact Teledyne Isco's SPA department for more details.

☑ Note

Only the Wall Mount Bracket is approved for use in classified hazardous locations. Non-Isco hardware must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

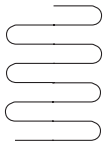
⚠ WARNING

The mounting bracket is a potential isolated charge carrier. For classified hazardous locations, your installation MUST satisfy earthing requirements. Refer to IEC 60079-14 section 12.2.4 and IEC 60079-11.

⚠ WARNING

Do not coil the sensor cable; this will form an inductor and create a hazard. The cable should be kept as short as is practical. If necessary, use a serpentine loop (see figure at left) instead.

Serpentine loop



2.4.1 Important Information Regarding "X" Marking

The ATEX labeling on the serial tag of the 310 device includes a number ending in "X." The X marking indicates that there are specific conditions that must be met in order for the equipment to comply with intrinsic safety requirements. Refer to Figure 2-8 on the following page.

These specific conditions are as follows:

- The integral cable must be terminated in a manner suitable for the zone of installation.
- No additional cable must be added to the sensor during the installation and the sensor integral cable must be connected directly to the terminals of the associated apparatus.
- The Li and Ci of the associated apparatus must be negligible.
- The physical spacing between the exposed ends of each insulated wire lead, and earth ground and other IS

circuits, must be such that the equipment is isolated up to 500V, and to 1500V for non-IS circuitry.

- The physical spacing between the end of the wire jacketing and the terminal to which a lead is connected must be such that solid foreign objects of 12.5mm ∅ and greater shall not be able to fully penetrate.

2.4.2 Electrical Requirements

Always refer to the electrical values listed at the bottom of the 310 serial tag when connecting associated apparatus (i.e., power supply, network interface, etc.).

This labeling indicates the maximum input voltage (Ui), maximum input current (Ii), and maximum power (Pi) that can be present at the specified terminals without invalidating intrinsic safety.

The power supply parameter allowances *must exceed* maximum internal capacitance (Ci) and either the maximum internal inductance (Li), or the maximum internal inductance-to-resistance ratio (Li/Ri) of the 310 device and integral cable. These parameters are established on the third party certification report and are available by contacting Teledyne Isco.

2.4.3 Ambient Environment

Installation in designated hazardous areas must fall within the temperature range of -40 to +60°C, as specified on the serial tag labeling.

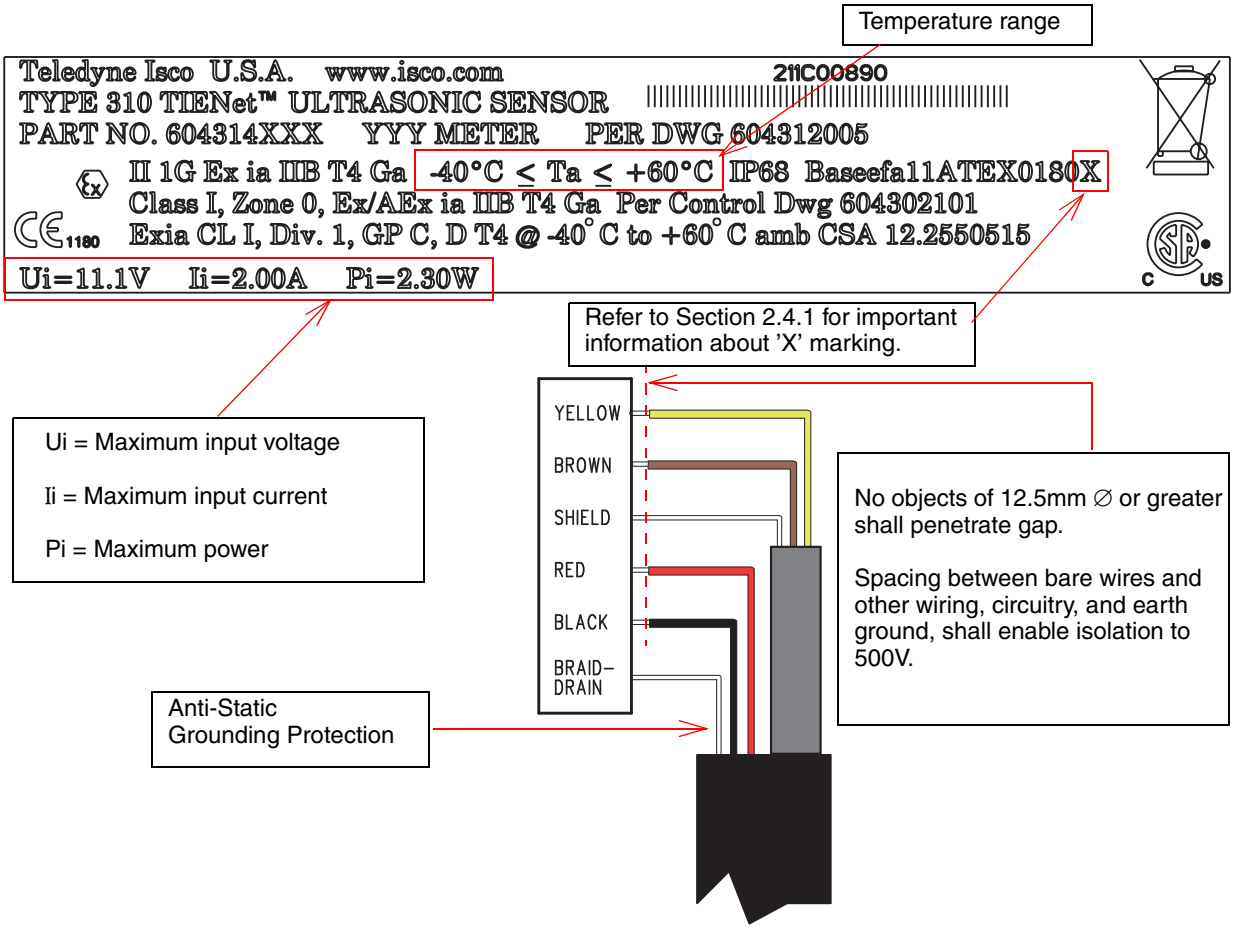

Temperature range
Teledyne Isco U.S.A. www.isco.com
211C00890
TYPE 310 TIENet™ ULTRASONIC SENSOR
PART NO. 604314XXX YYY METER PER DWG 604312005
II 1G Ex ia IIB T4 Ga -40°C ≤ Ta ≤ +60°C IP68 Baseefa11ATEX0180X
Class I, Zone 0, Ex/AEx ia IIB T4 Ga Per Control Dwg 604302101
Exia CL I, Div. 1, GP C, D T4 @ -40° C to +60° C amb CSA 12.2550515
Ui=11.1V Ii=2.00A Pi=2.30W
Refer to Section 2.4.1 for important information about 'X' marking.
Ui = Maximum input voltage
Ii = Maximum input current
Pi = Maximum power
YELLOW
BROWN
SHIELD
RED
BLACK
BRAID–DRAIN
No objects of 12.5mm ∅ or greater shall penetrate gap.
Spacing between bare wires and other wiring, circuitry, and earth ground, shall enable isolation to 500V.
Anti-Static Grounding Protection

Figure 2-8 Sensor labeling regarding hazloc installations

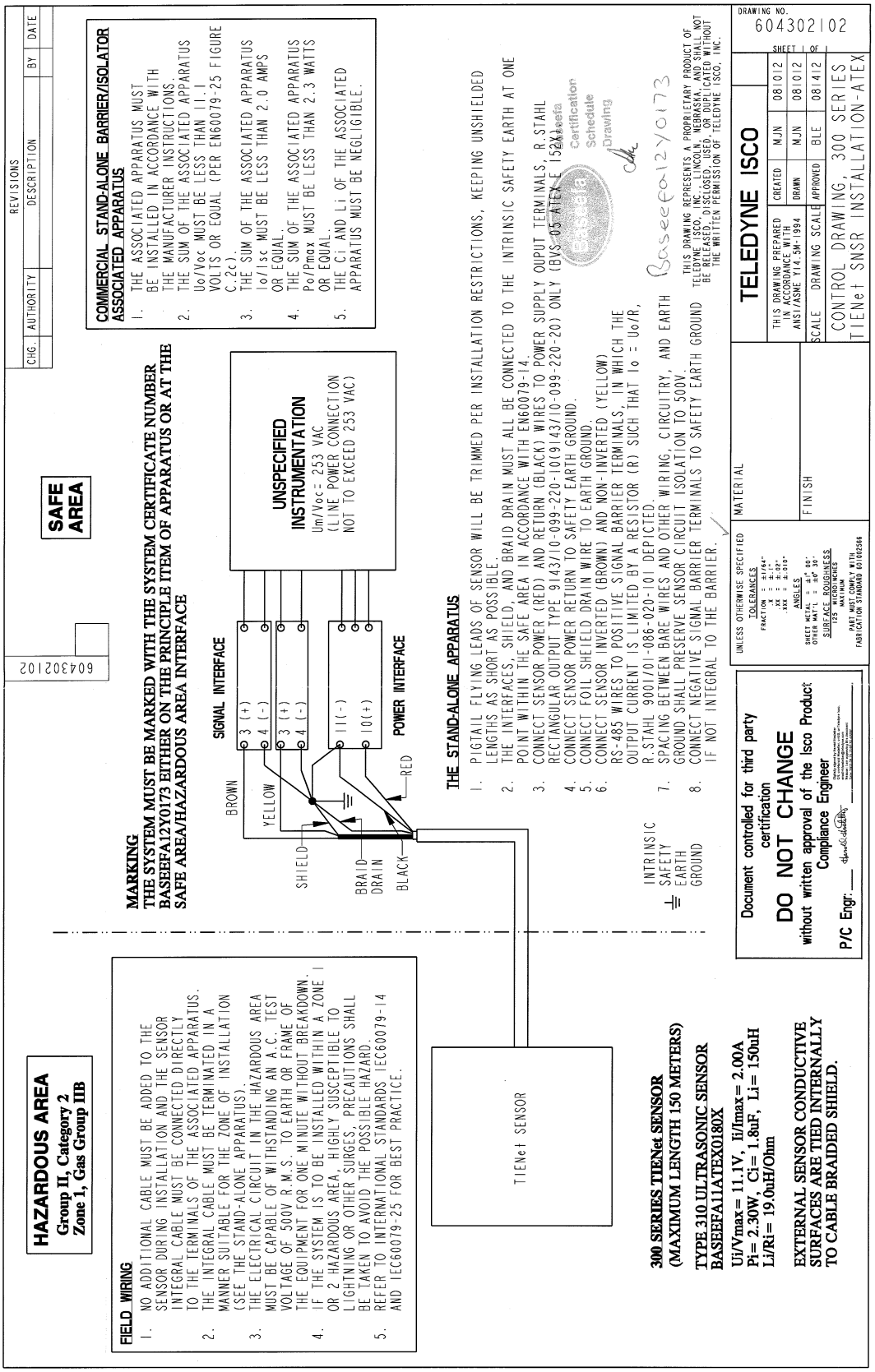

REVISIONS
CHG. AUTHORITY DESCRIPTION BY DATE
SAFE AREA
604302102
COMMERCIAL STAND-ALONE BARRIER/ISOLATOR ASSOCIATED APPARATUS
1. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER INSTRUCTIONS.
2. THE SUM OF THE ASSOCIATED APPARATUS Uo/Voc MUST BE LESS THAN 11.1 VOLTS OR EQUAL (PER EN60079-25 FIGURE C.2c).
3. THE SUM OF THE ASSOCIATED APPARATUS Io/Isc MUST BE LESS THAN 2.0 AMPS OR EQUAL.
4. THE SUM OF THE ASSOCIATED APPARATUS Po/Pmax MUST BE LESS THAN 2.3 WATTS OR EQUAL.
5. THE Ci AND Li OF THE ASSOCIATED APPARATUS MUST BE NEGLIGIBLE.
MARKING
THE SYSTEM MUST BE MARKED WITH THE SYSTEM CERTIFICATE NUMBER BASEEFA12Y0173 EITHER ON THE PRINCIPLE ITEM OF APPARATUS OR AT THE SAFE AREA/HAZARDOUS AREA INTERFACE
SIGNAL INTERFACE
POWER INTERFACE
UNSPECIFIED INSTRUMENTATION
Um/Voc = 253 VAC
(LINE POWER CONNECTION NOT TO EXCEED 253 VAC)
BROWN
YELLOW
SHIELD
BRAID DRAIN
BLACK
RED
3 (+)
4 (-)
11(-)
10(+)
THE STAND-ALONE APPARATUS
1. PIGTAIL FLYING LEADS OF SENSOR WILL BE TRIMMED PER INSTALLATION RESTRICTIONS, KEEPING UNSHIELDED LENGTHS AS SHORT AS POSSIBLE.
2. THE INTERFACES, SHIELD, AND BRAID DRAIN MUST ALL BE CONNECTED TO THE INTRINSIC SAFETY EARTH AT ONE POINT WITHIN THE SAFE AREA IN ACCORDANCE WITH EN60079-14.
3. CONNECT SENSOR POWER (RED) AND RETURN (BLACK) WIRES TO POWER SUPPLY OUPUT TERMINALS, R.STAHL RECTANGULAR OUTPUT TYPE 9143/10-099-220-10(9143/10-099-220-20) ONLY (BVS 05 ATEX E 152).
4. CONNECT SENSOR POWER RETURN TO SAFETY EARTH GROUND.
5. CONNECT FOIL SHEILD DRAIN WIRE TO EARTH GROUND.
6. CONNECT SENSOR INVERTED (BROWN) AND NON-INVERTED (YELLOW) RS-485 WIRES TO POSITIVE SIGNAL BARRIER TERMINALS, IN WHICH THE OUTPUT CURRENT IS LIMITED BY A RESISTOR (R) SUCH THAT Io = Uo/R, R.STAHL 9001/01-086-020-101 DEPICTED.
7. SPACING BETWEEN BARE WIRES AND OTHER WIRING, CIRCUITRY, AND EARTH GROUND SHALL PRESERVE SENSOR CIRCUIT ISOLATION TO 500V.
8. CONNECT NEGATIVE SIGNAL BARRIER TERMINALS TO SAFETY EARTH GROUND IF NOT INTEGRAL TO THE BARRIER.
INTRINSIC SAFETY EARTH GROUND
HAZARDOUS AREA
Group II, Category 2
Zone 1, Gas Group IIB
FIELD WIRING
1. NO ADDITIONAL CABLE MUST BE ADDED TO THE SENSOR DURING INSTALLATION AND THE SENSOR INTEGRAL CABLE MUST BE CONNECTED DIRECTLY TO THE TERMINALS OF THE ASSOCIATED APPARATUS.
2. THE INTEGRAL CABLE MUST BE TERMINATED IN A MANNER SUITABLE FOR THE ZONE OF INSTALLATION (SEE THE STAND-ALONE APPARATUS).
3. THE ELECTRICAL CIRCUIT IN THE HAZARDOUS AREA MUST BE CAPABLE OF WITHSTANDING AN A.C. TEST VOLTAGE OF 500V R.M.S. TO EARTH OR FRAME OF THE EQUIPMENT FOR ONE MINUTE WITHOUT BREAKDOWN.
4. IF THE SYSTEM IS TO BE INSTALLED WITHIN A ZONE 1 OR 2 HAZARDOUS AREA, HIGHLY SUSCEPTIBLE TO LIGHTNING OR OTHER SURGES, PRECAUTIONS SHALL BE TAKEN TO AVOID THE POSSIBLE HAZARD.
5. REFER TO INTERNATIONAL STANDARDS IEC60079-14 AND IEC60079-25 FOR BEST PRACTICE.
TIENet SENSOR
300 SERIES TIENet SENSOR
(MAXIMUM LENGTH 150 METERS)
TYPE 310 ULTRASONIC SENSOR
BASEEFA11ATEX0180X
Ui/Vmax= 11.1V, Ii/Imax= 2.00A
Pi= 2.30W, Ci= 1.8uF, Li= 150uH
Li/Ri= 19.0uH/Ohm
EXTERNAL SENSOR CONDUCTIVE SURFACES ARE TIED INTERNALLY TO CABLE BRAIDED SHIELD.
Document controlled for third party certification
DO NOT CHANGE
without written approval of the Isco Product Compliance Engineer
P/C Engr:
UNLESS OTHERWISE SPECIFIED
TOLERANCES
MATERIAL
FINISH
THIS DRAWING REPRESENTS A PROPRIETARY PRODUCT OF TELEDYNE ISCO, INC. LINCOLN, NEBRASKA, AND SHALL NOT BE RELEASED, DISCLOSED, USED, OR DUPLICATED WITHOUT THE WRITTEN PERMISSION OF TELEDYNE ISCO, INC.
TELEDYNE ISCO
THIS DRAWING PREPARED IN ACCORDANCE WITH ANSI/ASME Y14.5M-1994
CREATED M.JN 08|01|2
DRAWN M.JN 08|01|2
SCALE DRAWING SCALE APPROVED BLE 08|41|2
CONTROL DRAWING, 300 SERIES TIENet SNSR INSTALLATION-ATEX
DRAWING NO. 604302102
SHEET 1 OF
Baseefa12Y0173
Certificate
Schedule
Drawing

Figure 2-9 Hazardous Location Installation Control Drawing-Atex

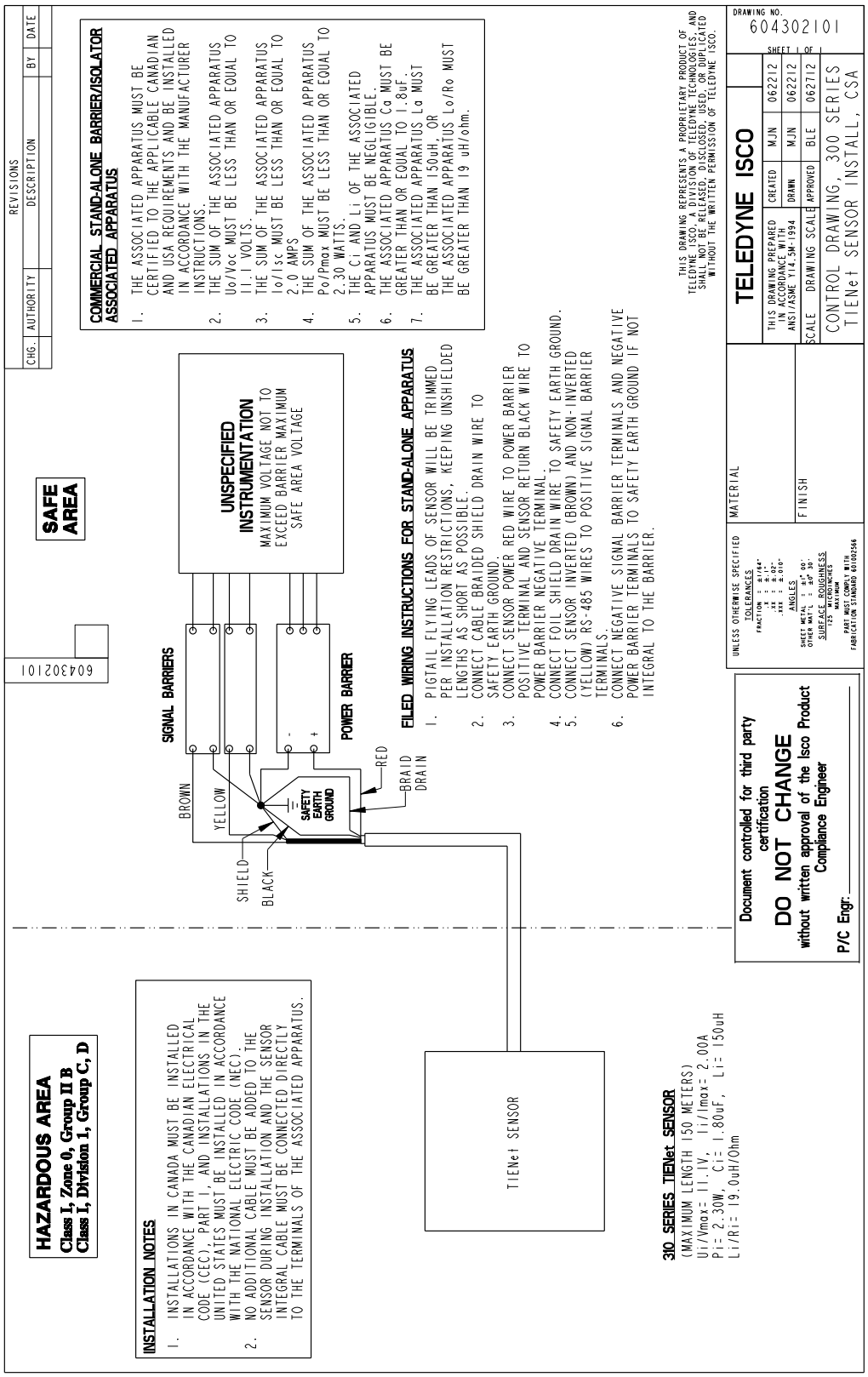

REVISIONS
CHG. | AUTHORITY | DESCRIPTION | BY | DATE
HAZARDOUS AREA
Class I, Zone 0, Group II B
Class I, Division 1, Group C, D
SAFE AREA
604302101
SIGNAL BARRIERS
POWER BARRIER
BROWN
YELLOW
SHIELD
BLACK
RED
BRAID
DRAIN
SAFETY EARTH GROUND
UNSPECIFIED INSTRUMENTATION
MAXIMUM VOLTAGE NOT TO EXCEED BARRIER MAXIMUM SAFE AREA VOLTAGE
TIENet SENSOR
INSTALLATION NOTES
1. INSTALLATIONS IN CANADA MUST BE INSTALLED IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE (CEC), PART I, AND INSTALLATIONS IN THE UNITED STATES MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC).
2. NO ADDITIONAL CABLE MUST BE ADDED TO THE SENSOR DURING INSTALLATION AND THE SENSOR INTEGRAL CABLE MUST BE CONNECTED DIRECTLY TO THE TERMINALS OF THE ASSOCIATED APPARATUS.
310 SERIES TIENet SENSOR
(MAXIMUM LENGTH 150 METERS)
Ui/Vmax= 11.1V, Ii/Imax= 2.00A
Pi= 2.30W, Ci= 1.80uF, Li= 150uH
Li/Ri= 19.0uH/Ohm
FILED WIRING INSTRUCTIONS FOR STAND-ALONE APPARATUS
1. PIGTAIL FLYING LEADS OF SENSOR WILL BE TRIMMED PER INSTALLATION RESTRICTIONS, KEEPING UNSHIELDED LENGTHS AS SHORT AS POSSIBLE.
2. CONNECT CABLE BRAIDED SHIELD DRAIN WIRE TO SAFETY EARTH GROUND.
3. CONNECT SENSOR POWER RED WIRE TO POWER BARRIER POSITIVE TERMINAL AND SENSOR RETURN BLACK WIRE TO POWER BARRIER NEGATIVE TERMINAL.
4. CONNECT FOIL SHIELD DRAIN WIRE TO SAFETY EARTH GROUND.
5. CONNECT SENSOR INVERTED (BROWN) AND NON-INVERTED (YELLOW) RS-485 WIRES TO POSITIVE SIGNAL BARRIER TERMINALS.
6. CONNECT NEGATIVE SIGNAL BARRIER TERMINALS AND NEGATIVE POWER BARRIER TERMINALS TO SAFETY EARTH GROUND IF NOT INTEGRAL TO THE BARRIER.
COMMERCIAL STAND-ALONE BARRIER/ISOLATOR ASSOCIATED APPARATUS
1. THE ASSOCIATED APPARATUS MUST BE CERTIFIED TO THE APPLICABLE CANADIAN AND USA REQUIREMENTS AND BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER INSTRUCTIONS.
2. THE SUM OF THE ASSOCIATED APPARATUS Uo/Voc MUST BE LESS THAN OR EQUAL TO 11.1 VOLTS.
3. THE SUM OF THE ASSOCIATED APPARATUS Io/Isc MUST BE LESS THAN OR EQUAL TO 2.0 AMPS.
4. THE SUM OF THE ASSOCIATED APPARATUS Po/Pmax MUST BE LESS THAN OR EQUAL TO 2.30 WATTS.
5. THE Ci AND Li OF THE ASSOCIATED APPARATUS MUST BE NEGLIGIBLE.
6. THE ASSOCIATED APPARATUS Ca MUST BE GREATER THAN OR EQUAL TO 1.8uF.
7. THE ASSOCIATED APPARATUS La MUST BE GREATER THAN 150uH, OR THE ASSOCIATED APPARATUS Lo/Ro MUST BE GREATER THAN 19 uH/ohm.
Document controlled for third party certification
DO NOT CHANGE
without written approval of the Isco Product Compliance Engineer
P/C Engr:
UNLESS OTHERWISE SPECIFIED TOLERANCES
MATERIAL
FINISH
THIS DRAWING REPRESENTS A PROPRIETARY PRODUCT OF TELEDYNE ISCO, A DIVISION OF TELEDYNE TECHNOLOGIES AND SHALL NOT BE REPRODUCED, USED OR DISCLOSED IN WHOLE OR PART WITHOUT THE WRITTEN PERMISSION OF TELEDYNE ISCO.
TELEDYNE ISCO
THIS DRAWING PREPARED IN ACCORDANCE WITH ANSI/ASME Y14.5M-1994
CREATED MJN 062212
DRAWN MJN 062212
APPROVED BLE 062712
SCALE DRAWING SCALE
DRAWING NO. 604302101
SHEET OF
CONTROL DRAWING, 300 SERIES TIENet SENSOR INSTALL, CSA

Figure 2-10 Hazardous Location Installation Control Drawing-CSA

2.5 Configuring the System

To configure the Signature flow meter for operation with the TIENet 310 device, press MENU (B) to access the top menu, and select Hardware Setup. For all TIENet devices including the 310, select Smart Sensor Setup (TIENet).

2.5.1 Updating the Device List

When the 310 is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 310 appears in the list of connected devices, ready to be configured with the steps shown in Figure 2-12 on the following page.

> **Note**
> From the Hardware Setup menu, "Configure" refers to defining and selecting the parameters for each connected device.

The four parameters that will appear for the 310 device are:

310 Distance – Distance between the bottom of the sensor and the surface of the flow stream.

310 Air Temperature – Temperature of surrounding (ambient) air

310 Level – Level of the flow stream surface

310 Signal – Strength of the return echo

The name of any parameter can be customized by highlighting it and pressing Enter ( ) to display the character grid. Navigate the grid using the arrow keys. Select characters with Enter and clear characters with Delete ( ).

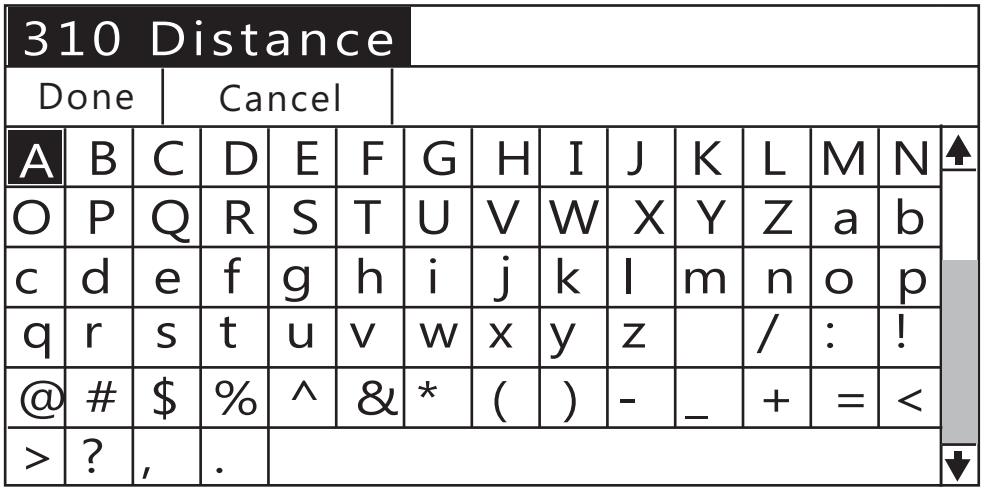


Figure 2-11 Character grid

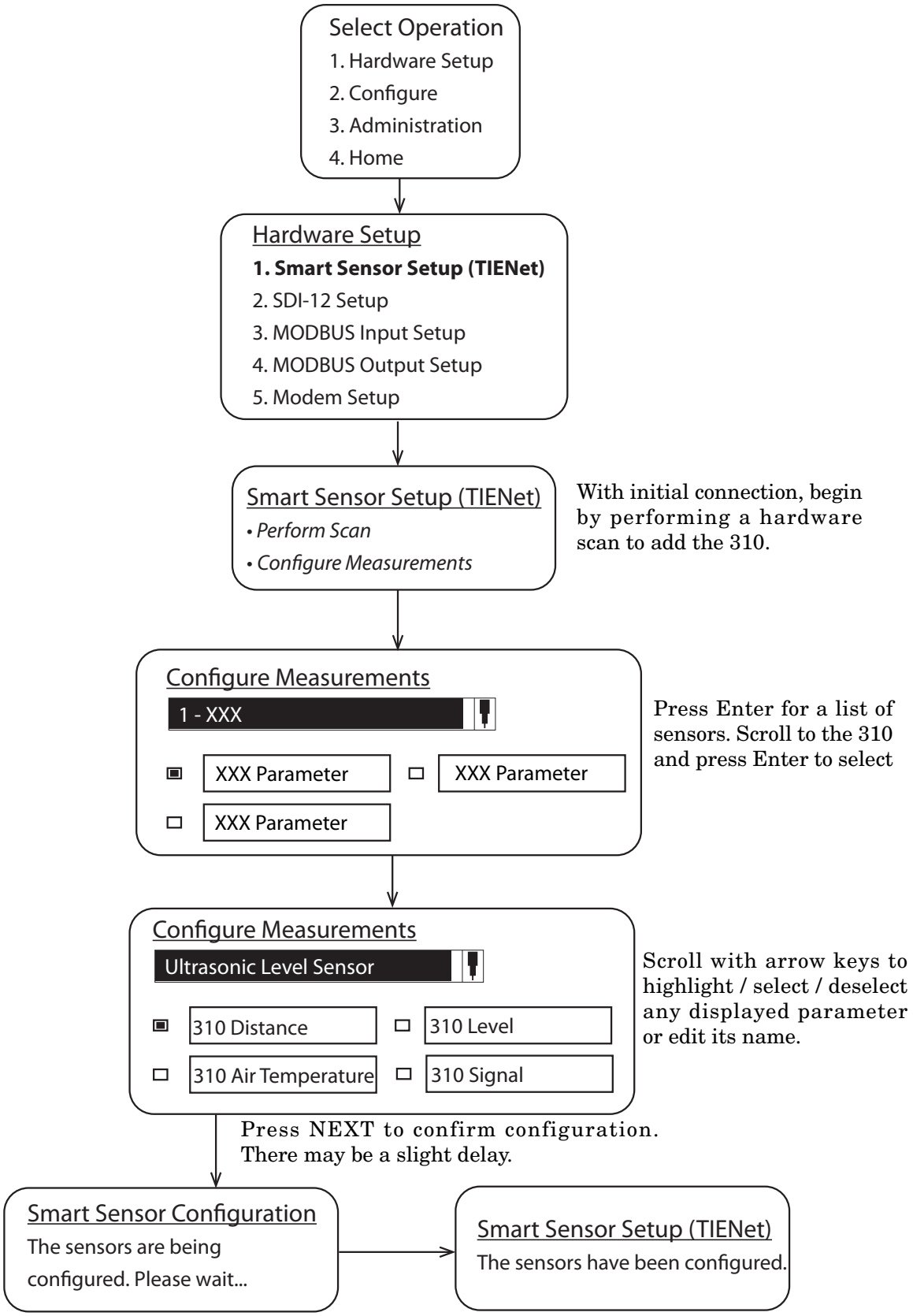

Select Operation
1. Hardware Setup
2. Configure
3. Administration
4. Home
Hardware Setup
1. Smart Sensor Setup (TIENet)
2. SDI-12 Setup
3. MODBUS Input Setup
4. MODBUS Output Setup
5. Modem Setup
Smart Sensor Setup (TIENet)
• Perform Scan
• Configure Measurements
With initial connection, begin by performing a hardware scan to add the 310.
Configure Measurements
1 - XXX
XXX Parameter
XXX Parameter
XXX Parameter
Press Enter for a list of sensors. Scroll to the 310 and press Enter to select
Configure Measurements
Ultrasonic Level Sensor
310 Distance
310 Level
310 Air Temperature
310 Signal
Scroll with arrow keys to highlight / select / deselect any displayed parameter or edit its name.
Press NEXT to confirm configuration.
There may be a slight delay.
Smart Sensor Configuration
The sensors are being configured. Please wait...
Smart Sensor Setup (TIENet)
The sensors have been configured.

Figure 2-12 Menu Tree: 310 Configuration

2.5.2 Measurement Setup

From Measurement Setup (Figure 2-13 below), select Level Input Setup to define the measurement range.

The **Minimum Blanking Distance** is the shortest distance from the sensor face (highest expected liquid level). Because of the dead band, this value can never be less than one foot. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the sensor face and the bottom of the channel, or zero level. You can enter a slightly larger value than calculated, if you prefer.

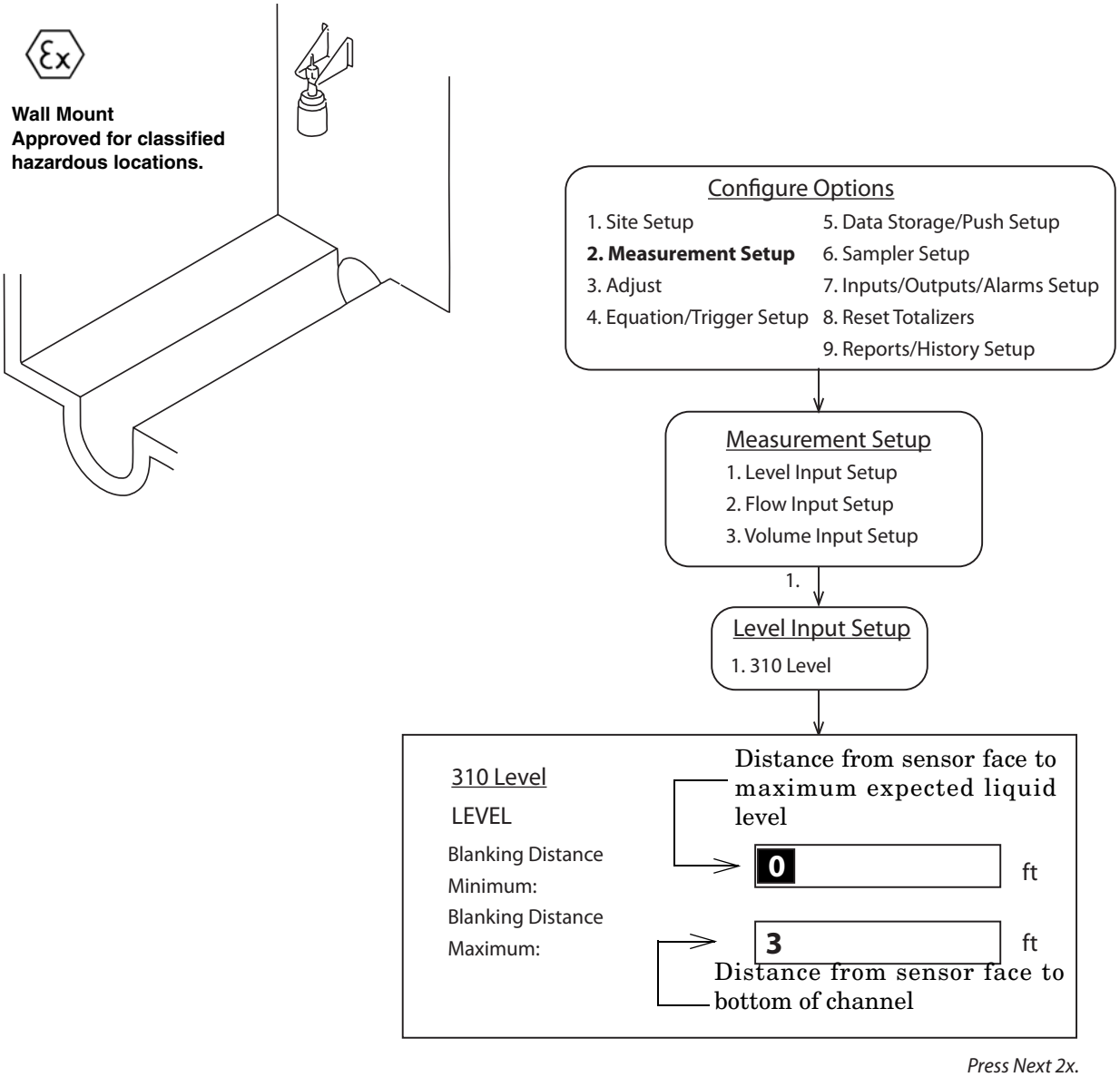
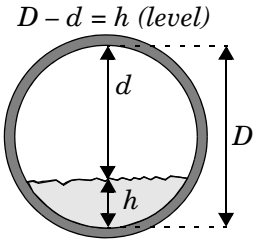


Figure 2-13 Configuring ultrasonic level measurement

2.6 Level Calibration



Although all other programming steps can be performed off-site, level must be set at the measurement site following installation, at ambient temperature.

Once the sensor is installed over the flow stream, measure the present liquid level (see figure at left) and enter this value for Level, under Adjust Options. Then highlight "Adjust" and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

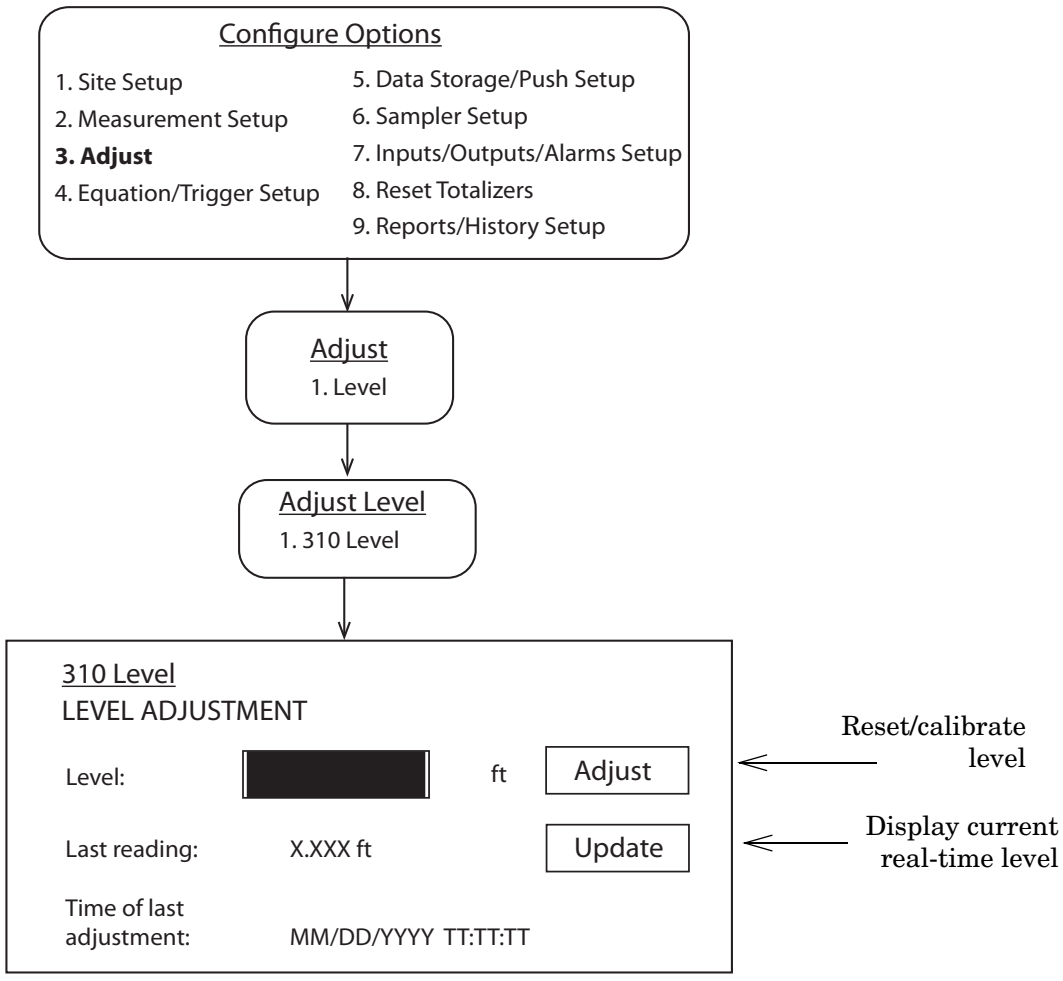


Figure 2-14 Ultrasonic level adjustment and calibration

2.7 Firmware Updates

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

2.8 Troubleshooting TIENet 310 USLS

Table 2-1 Troubleshooting: TIENet 310 Ultrasonic Level Sensor

Symptom	Cause	Action
Invalid level, display has asterisk (*) by level reading	Not scanned	Perform a smart sensor scan
	Not able to achieve signal lock (misalignment, loose mounting, turbulence, foam, or debris in the water)	Adjust mounting or place over a solid surface.
	Level outside of the Blanking distances	Adjust min/max blanking distances
	Not wired correctly	Check/repair wiring
	Open fuse	Replace fuse FU-T 3.15A and rescan. Part #411-0212-70. Refer to Figure 3-2 Item K.
	Failed sensor	Replace with known good sensor
No level reading on the display	Parameter not selected to be displayed on Home Display	Add the parameter to the Home Display. Refer to Section 2.7.1 *Site Setup*.
Incorrect level reading	Level not adjusted properly	Readjust level
	Sensor misaligned	Realign sensor
	Objects in the path of the signal	Adjust min/max blanking distances and/or reposition sensor.
	Sensor exposed to direct sunlight	Install sunshade. Refer to Appendix Appendix B *Options and Accessories*.

2.9 Contact Teledyne Isco

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact our service department at:

Teledyne Isco
4700 Superior St.
Lincoln, NE 68504

Phone: 866 298-6174 or 402 464-0231
Fax: 402 465-3022
E-mail: IscoService@teledyne.com

TIENet® Model 310 Ultrasonic Level Sensor

Appendix A Replacement Parts

A.1 Replacement Parts

Replacement parts are called out in the following illustrations. Refer to the call-out in the adjacent table to determine the part number for the item.

Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX:(402) 465-3022

E-mail:IscoInfo@teledyne.com

A.1.1 TIENet 310 Ultrasonic Level Sensor Replacement Parts

Split mounting Nut 60-4313-007
Cap Sensor Connector 60-4314-011
310 Ultrasonic sensor Cut-to-length 60-4314-014
O-Ring Sensor Connector 20-2100-669
Screw Connector Cap #4-40 X1/4 23-1014-304

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O
电磁阀 Solenoid valve	X	O	O	O	O	X

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

DECLARATION OF CONFORMITY

Application of Council Directive:	2004/108/EC-The EMC Directive 2006/95/EC- The Low Voltage Directive 94/9/EC - The ATEX Directive
Manufacturer's Name:	Teledyne Isco
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Equipment for Light Industrial/Commercial Environments: The device is an ultrasonic transmitter/receiver using reflected impulses from water surfaces to calculate its depth. It is cable connected to flow monitoring instruments and consists of several circuit board assemblies inside a plastic enclosure. The device is intended for safe operation in an ambient temperature range of -40 to +60 C.
Trade Name/Model No:	**310 Ultrasonic Sensor**
Year of Issue:	2011
Provisions of the Directive fulfilled by the Equipment:	II 1G Ex ia IIB T4 Ga (-40C ≤ Ta ≤ +60C) IP68 (self-certified; submerged 9 meters for 72 hours)
Notified Body for EC-Type Examination:	Baseefa 1180 Buxton UK
EC-type Examination Certificate:	Model Type 310 Ultra Sonic Sensor: Baseffa11ATEX0180X Issued December 8, 2011
Notified Body for Production:	Baseefa 1180 Buxton UK
Harmonized Safety Standards:	EN60079-0:2009, EN60079-11:2007
Other Harmonized Standards and Specifications used:	EN 61326-1998 - EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN60529:1992 - Degrees of Protection Provided by Enclosure; IP-68

I, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of December 20, 2011.

USA Representative:

Vikas V. Padhye Ph.D.
Vice President and General Manager
Teledyne Isco Inc.
4700 Superior Street
Lincoln, Nebraska 68504
Phone: (402)-464-0231
FAX: (402)-464-0318

TELEDYNE ISCO
A Teledyne Technologies Company

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as pH sensors, charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address:	Teledyne Isco - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA
Mailing Address:	Teledyne Isco PO Box 82531 Lincoln, NE 68501 USA
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